

* The date(Create Date, Approved Date, Check Date) is based on Korean standard time(GMT+9)

Created Date	2010-03-25 23:03 (Korea Time)		
Requested by	윤석재 (BS Module그룹 / 과장 , 82-31-610-9654)		
Subject	[Formal Approval] LGD 18.5"W EMPC 200nits(Fab/S-IC multi)		
EDMS Attributes	Biz Map	Procure Materials and Services > Develop Procurement Strategy	
	Team Map	BS Sourcing팀 > BS Module전략Sourcing그룹	
	Doc Type	Approval	Retention 5 Year
	Info Type		
	Security Grade	Internal use (Only)	Doc Language Korean

Component Development Information

Model : W1943C
Approval type : New (●) Limit () Revision () 4M ()
HSMS (RoHS) : Complete (●) Limit Approval () Warranty Approval ()
Reliability test : Needless () Need (Test Report No: ●)
Module Name : LM185WH1-TLH1/2/3/4/5/6/7/8
Part Number :

Model	P/N	ZBD/Non-ZBD	Fab/S-IC
LM185WH1-TLH1	EAJ60988501	ZBD	P6/Lusem
LM185WH1-TLH5	EAJ60988502	TLH1's Non-ZBD	P6/Lusem
LM185WH1-TLH3	EAJ60988601	ZBD	P6/Magna
LM185WH1-TLH6	EAJ60988602	TLH3's Non-ZBD	P6/Magna
LM185WH1-TLH2	EAJ61310401	ZBD	P6E/Lusem
LM185WH1-TLH7	EAJ61310402	TLH2's Non-ZBD	P6E/Lusem
LM185WH1-TLH4	EAJ61310501	ZBD	P6E/Magna
LM185WH1-TLH8	EAJ61310502	TLH4's Non-ZBD	P6E/Magna

Maker : LG Display
Specification : LM185WH1-TLH HD 18.5INCH 1366X768 200CD COLOR 72% 16/9 600:1 V/A 50/90 R/T 5ms
Key parts list : Fab P6/P6E, Module assy GM/GZ, C/F LGD, PoI LGC, T-con LGE, S-IC Lusem/Magna, GIP,
B/L ass'y Newoptics/L&F, Lamp Heesund, B/L sheet Diffuser+Diffuser
Development History : LGD 18.5"W EMPC Development

★Safety Standard Parts [안전규격부품 List]
Power Cord, Power Plug, X / Y-Capacitor, Power Switch, Fuse, SMPS Trans, Stand-By Trans, Photo coupler, Insulation (절연) Resistor, Discharge (방전)Resistor, Fusing Resistor, FBT,CPT, CPT Socket, DY, D-Coil, Line Filter, PCB Material, Front / Back-cover Material, Relay(1-2차간), Varistor, Adaptor, PSU(Power supply unit)
★EMC Standard Parts [전파규격 부품 List]
Power Plug, Line Filter, X-Capacitor, Y-Capacitor, SMPS Trans, Tuner, Saw-Filter, Shield Case, Oscillator, Pattern Change
★Green [유해물질 확인사항]
This item must meet the standards of LG Electronics for six major substances as designated by RoHS for control.

Approval Line	Approval Type	Status	Approved Date	Approved by / Comment
	Agree	Approved	2010-03-29 12:39	HUI KANG (LGEND R&D.COMPONENT DEVELOPMENT GROUP / assist manager) Comment : ok
	Agree	Approved	2010-03-29 12:43	HUAN CHEN (LGEND R&D.MNT PLANNING GROUP / assist manager) Comment : OK
	Agree	Approved	2010-03-29 14:18	danyang huang (LGEND R&D.MNT PLANNING GROUP / manager b)
	Agree	Approved	2010-03-29 15:43	차상호 (평택규격그룹 / 책임연구원) Comment : 확인합니다.
	Agree	Approved	2010-03-29 15:58	이성수 (평택규격그룹 / 주임연구원) Comment : 확인합니다.
	Agree	Approved	2010-03-29 18:04	배권일 (LGEND R&D.COMPONENT DEVELOPMENT GROUP / 수석연구원) Comment : 확인합니다.
				황동선 (LGEND R&D.MNT S/W GROUP / 수석연구원)



	Agree	Approved	2010-03-30 09:56	Comment : ok
	Approval	Approved	2010-03-30 17:30	정동원 (BS Module그룹 / 차장) Comment : 확인합니다.
CC	정길식 (Monitor기구개발그룹 / 책임연구원) 윤시열 (MonitorR&D기획그룹 / 수석연구원) 정동원 (BS Module그룹 / 차장) 송재학 (Monitor QA그룹 / 차장) 정지현 (LGEIN PURCHASING DISPLAY GROUP / 과장) 박동호 (BS Module그룹 / 부장) 황병연 (Monitor회로개발그룹 / 주임연구원) 이기형 (MonitorR&D기획그룹 / 선임연구원) 최찬용 (BS Module그룹 / 대리) 송성호 (Monitor회로개발그룹 / 선임연구원) 김경진 (부품품질보증계 / 기사) 이상훈 (Monitor회로개발그룹 / 책임연구원) 허희준 (MonitorR&D기획그룹 / 선임연구원) 김희남 (Monitor회로개발그룹 / 주임연구원) 손현우 (Monitor회로개발그룹 / 선임연구원) 박종철 (Monitor회로개발그룹 / 주임연구원) 김부영 (MonitorR&D기획그룹 / 주임연구원) 류정일 (Monitor회로개발그룹 / 주임연구원) 이송화 (BS Module그룹 / 대리) 김영주 (MonitorR&D기획그룹 / 연구원) 이성수 (평택규격그룹 / 주임연구원) 이지수 (BS조달그룹 / 사원) 양선연 (Monitor회로개발그룹 / 주임연구원) 임철재 (Monitor회로개발그룹 / 주임연구원) 이연정 (Monitor회로개발그룹 / 연구원) 임창성 (Monitor QA그룹 / 과장) 김아련 (MonitorR&D기획그룹 / 주임연구원) 윤석재 (BS Module그룹 / 과장) 손상준 (Monitor회로개발그룹 / 책임연구원) 이종수 (BS Module그룹 / 대리) 이재민 (Monitor회로개발그룹 / 수석연구원) 황동선 (LGEND R&D.MNT S/W GROUP / 수석연구원) 김종태 (Monitor회로개발그룹 / 수석연구원) 김주만 (LGEIN R&D DISPLAY ELECT GROUP / 수석연구원) 박일준 (LGEIN R&D DISPLAY MECH GROUP / 수석연구원) 이명규 (평택규격그룹 / 수석연구원) 배권일 (LGEND R&D.COMPONENT DEVELOPMENT GROUP / 수석연구원) 차상호 (평택규격그룹 / 책임연구원) 박우근 (BS조달그룹 / 차장) 김명욱 (Monitor회로개발그룹 / 수석연구원) 배덕호 (Monitor기구개발그룹 / 책임연구원) 박강식 (부품품질보증계 / 기정) 박철진 (부품품질보증계 / 기정) SARWO SOVIANDY SIJABAT (LGEIN R&D DISPLAY LCD MNT PART / sr. supervisor) pinqun zhou (LGEND R&D.MNT MASS PRODUCTION GROUP / senior manager B) QIU YU (LGEND R&D.Power GROUP / manager b) xiaoyong zhang (LGEND R&D.MNT DEVELOPMENT GROUP / manager a) REN MING JIN (LGEND R&D.MNT MASS PRODUCTION GROUP / manager b) jian dong (SQA GROUP / Operator3) ke zhu (LGEND R&D.MNT MECHANIC GROUP / assist manager) CHENG XIANG ZHANG (LGEND PRODUCTION.MANUFACTURING GROUP / Operator2) wenxue li (LGEND R&D.MNT PLANNING GROUP / assist manager) guozhe zheng (LGEND PRODUCTION.CIRCUIT.PURCHASING GROUP / manager b) jie sun (LGEND R&D.MNT MASS PRODUCTION GROUP / Operator3) li zhao (LGEND R&D.MNT MASS PRODUCTION GROUP / Operator2) HUI KANG (LGEND R&D.COMPONENT DEVELOPMENT GROUP / assist manager) Linlin Zhao (LGEND R&D.MNT PLANNING GROUP / assist manager) su yuan (LGEND R&D.MNT PLANNING GROUP / officer 1) yong qing (LGEND R&D.MNT PLANNING GROUP / assist manager) FEI SUN (LGEND PRODUCTION.MATERIAL GROUP / Operator2) YU GUANG FEI (SQA GROUP / assist manager) YU HAO ZHU (LGEND R&D.MNT MECHANIC GROUP / officer 1) wanji zheng (LGEND R&D.COMPONENT DEVELOPMENT GROUP / officer 1)			
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Attached Local Files	📎 CAS_TLH1_2_5_7.zip 📎 IIS_TLH1_2_5_7.zip 📎 Document_TLH1_2_5_7.zip 📎 CAS_TLH3_4_6_8.zip 📎 IIS_TLH3_4_6_8.zip 📎 Document_TLH3_4_6_8.zip			

LM185WH1
Liquid Crystal Display**Product Specification****SPECIFICATION
FOR
APPROVAL**

() Preliminary Specification

(◆) Final Specification

Title		18.5" HD TFT LCD	
BUYER	LGE	SUPPLIER	LG Display Co., Ltd.
MODEL		*MODEL	LM185WH1
		SUFFIX	TLH4

*When you obtain standard approval,
please use the above model name without suffix

SIGNATURE	DATE
/	
/	
/	

Please return 1 copy for your confirmation
With your signature and comments.

APPROVED BY	DATE
S.G. HONG / G.Manager	3/18/2010
REVIEWED BY	
S.U. BYUN / Manager [C]	
Y.H. HWANG / Manager [M]	
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PREPARED BY	
B.Y. KIM / Engineer	

Product Engineering Dept.
LG Display Co., Ltd

LM185WH1
Liquid Crystal Display**Product Specification****Contents**

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LM185WH1
Liquid Crystal Display

Product Specification

Record of revisions

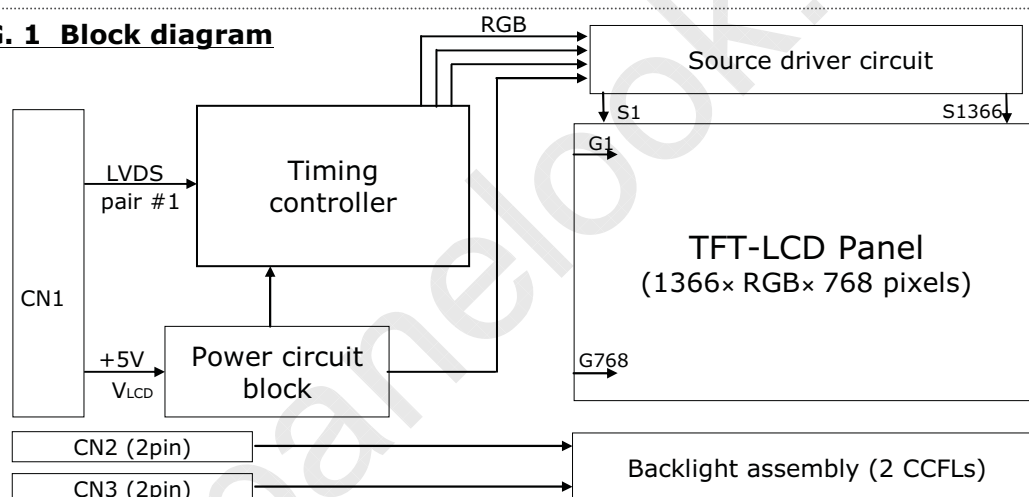
Revision No	Date	Page	Description																																												
Ver 0.0	OCT.,26,2009		Preliminary Specifications																																												
Ver 0.1	JAN.,12,2010	26	Change wire length dimension & Mark total wire length (165± 10) Change COF location because of mismark 113.8, 4.2, 105.4 → 140.05, 2.05, 135.95																																												
Ver 1.0	MAR.,09,2010	4 6	Update the weight : TBD → 1370g Changed values of power supply input current & power consumption → Before <table><tr><th rowspan="2">Parameter</th><th rowspan="2">Symbol</th><th colspan="3">Values</th></tr><tr><th>Min</th><th>Typ</th><th>Max</th></tr><tr><td rowspan="2">Power Supply Input Current</td><td>I_{LCD-MOSAIC}</td><td>-</td><td>730</td><td>840</td></tr><tr><td>I_{LCD-BLACK}</td><td>-</td><td>910</td><td>1050</td></tr><tr><td>Power Consumption</td><td>P_{LCD}</td><td>-</td><td>3.65</td><td>4.20</td></tr></table> → After <table><tr><th rowspan="2">Parameter</th><th rowspan="2">Symbol</th><th colspan="3">Values</th></tr><tr><th>Min</th><th>Typ</th><th>Max</th></tr><tr><td rowspan="2">Power Supply Input Current</td><td>I_{LCD-MOSAIC}</td><td>-</td><td>720</td><td>940</td></tr><tr><td>I_{LCD-BLACK}</td><td>-</td><td>900</td><td>1170</td></tr><tr><td>Power Consumption</td><td>P_{LCD}</td><td>-</td><td>3.60</td><td>4.70</td></tr></table> Change the power ripple : 0.2V → 0.3V Final Specifications	Parameter	Symbol	Values			Min	Typ	Max	Power Supply Input Current	I _{LCD-MOSAIC}	-	730	840	I _{LCD-BLACK}	-	910	1050	Power Consumption	P _{LCD}	-	3.65	4.20	Parameter	Symbol	Values			Min	Typ	Max	Power Supply Input Current	I _{LCD-MOSAIC}	-	720	940	I _{LCD-BLACK}	-	900	1170	Power Consumption	P _{LCD}	-	3.60	4.70
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Ver 2.0	MAR.,18,2010	20	Add the Viewing angle (CR>5) specifications																																												

Product Specification

1. General description

LM185WH1-TLH4 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. It has a 18.5 inch diagonally measured active display area with HD resolution (768 vertical by 1366 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M colors with Advanced-FRC(Frame Rate Control). It has been designed to apply the interface method that enables low power, high speed, low EMI. FPD Link or compatible must be used as a LVDS(Low Voltage Differential Signaling) chip. It is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM185WH1-TLH4 characteristics provide an excellent flat panel display for office automation products such as monitors.

FIG. 1 Block diagram



General features

Active screen size	18.51 inches (470.1mm) diagonal
Outline Dimension	430.4(H) x 254.6(V) x 13.0(D) mm(Typ.)
Pixel Pitch	0.10*RGB(H)mm x 0.30(V)mm
Pixel Format	1366 horizontal By 768 vertical Pixels. RGB stripe arrangement
Interface	LVDS 1Port
Color depth	16.7M colors
Luminance, white	200 cd/m ² (Center 1Point, typ)
Viewing Angle (CR>10)	R/L 90(Typ.), U/D 50(Typ.)
Power Consumption	Total 14.31W(Typ.), (3.60 W@V _{LCD} , 10.71W@I _{BL} = 8.5 mA)
Weight	1370g(Typ)
Display operating mode	Transmissive mode, Normally White
Surface treatments	Hard coating (3H), Anti-glare treatment of the front polarizer

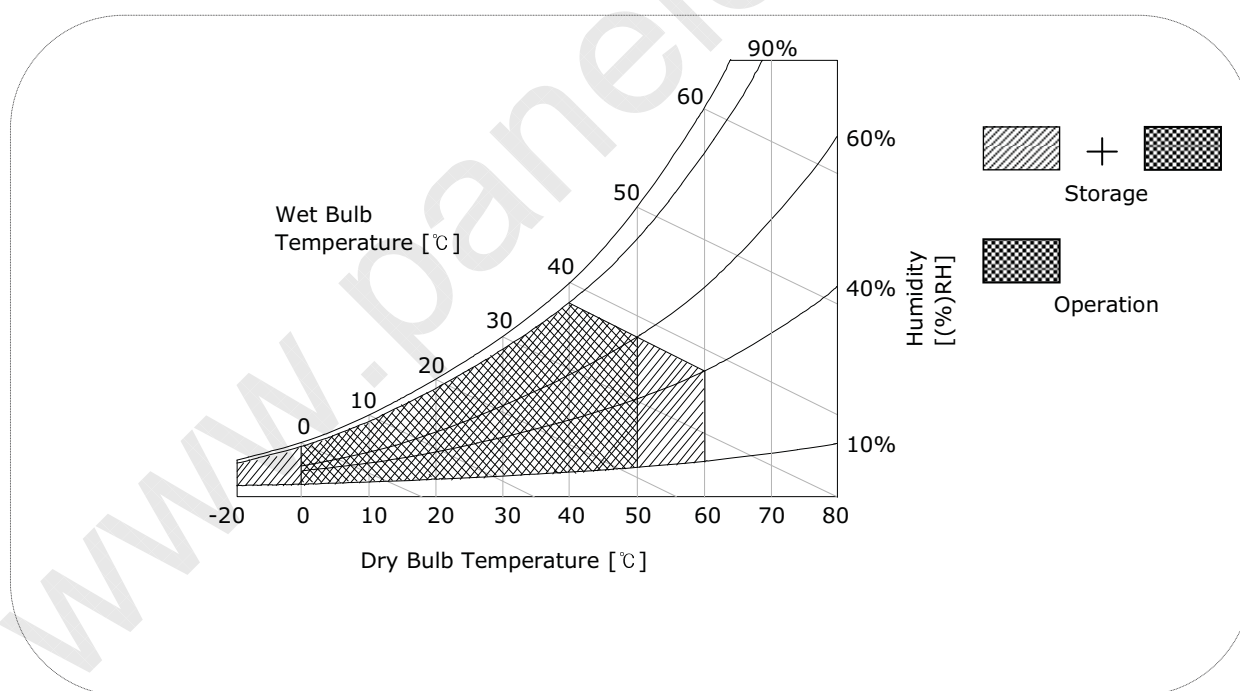
Product Specification
2. Absolute maximum ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. Absolute maximum ratings

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Supply Input Voltage	V_{LCD}	-0.3	+6.0	Vdc	At 25 °C
Operating Temperature	T_{OP}	0	50	°C	1
Storage Temperature	T_{ST}	-20	60	°C	
Operating Ambient Humidity	H_{OP}	10	90	%RH	
Storage Humidity	H_{ST}	10	90	%RH	

Note : 1. Temperature and relative humidity range are shown in the figure below.
 Wet bulb temperature should be 39 °C Max, and no condensation of water.

FIG. 2 Temperature and relative humidity


Product Specification

3. Electrical specifications

3-1. Electrical characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the CCFL/Backlight, is typically generated by an inverter. The inverter is an external unit to the LCDs.

Table 2. Electrical characteristics

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	V _{LCD}	4.5	5.0	5.5	Vdc	
Permissive Power Input Ripple	V _{LCD}	-	-	0.3	V	3
Power Supply Input Current	I _{LCD-MOSAIC}	-	720	940	mA	1
	I _{LCD-BLACK}	-	900	1170	mA	2
Power Consumption	P _{LCD}	-	3.60	4.70	Watt	1
Inrush current	I _{RUSH}	-	-	3.0	A	4

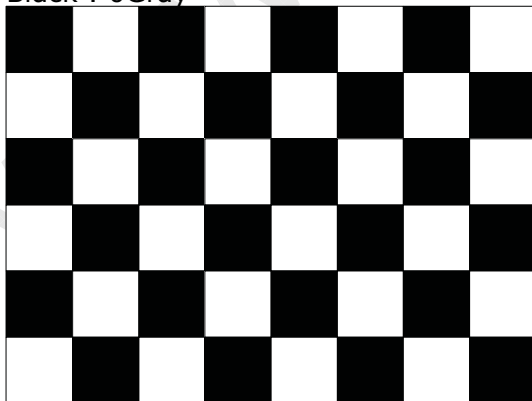
Note :

1. The specified current and power consumption are under the $V_{LCD}=5.0V$, $25 \pm 2^{\circ}C$, $f_v=60Hz$ condition whereas mosaic pattern(8 x 6) is displayed and f_v is the frame frequency.
2. The current is specified at the maximum current pattern.
3. Permissive power ripple should be measured under $VCC=5.0V$, $25^{\circ}C$, f_v (frame frequency)=75Hz condition and At that time, we recommend the bandwidth configuration of oscilloscope is to be under 20MHz.
4. The duration of rush current is about 5ms and rising time of power Input is $500us \pm 20\%$.

FIG.3 pattern for Electrical characteristics

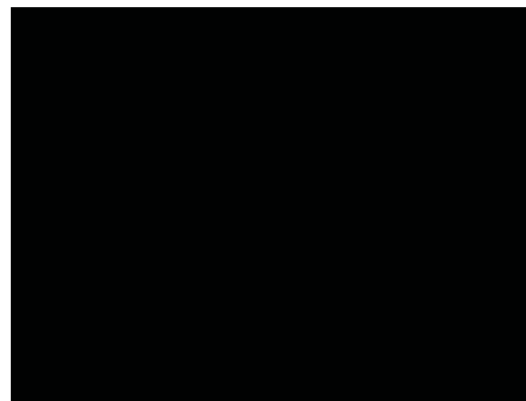
power consumption measurement

White : 255Gray
 Black : 0Gray



Mosaic Pattern(8 x 6)

power input ripple



Full Black Pattern

Product Specification
Table 3. Electrical characteristics

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LAMP :						
Operating Voltage	V _{BL}	620 (9.0mA)	630 (8.5mA)	810 (2.5mA)	V _{RMS}	1, 2
Operating Current	I _{BL}	2.5	8.5	9.0	mA _{RMS}	1
Established Starting Voltage	V _s					1, 3
	at 25 °C			1100	V _{RMS}	
	at 0 °C			1400	V _{RMS}	
Operating Frequency	f _{BL}	40	60	70	kHz	4
Discharge Stabilization Time	T _S	-	-	3	Min	1, 5
Power Consumption	P _{BL}		10.71	11.78	Watt	6
Life Time		50,000	-		Hrs	1, 7

Note :

The design of the inverter must have specifications for the lamp in LCD Assembly.

The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter (no lighting, flicker, etc) never occurs. When you confirm it, the LCD-Assembly should be operated in the same condition as installed in you instrument.

- ※ Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action.
 Because leakage current is occurred between lamp wire and conducting tape.

- Specified values are for a single lamp.
- Operating voltage is measured at $25 \pm 2^\circ\text{C}$. The variance of the voltage is $\pm 10\%$.
- The voltage above V_S should be applied to the lamps for more than 1 second for start-up.
 (Inverter open voltage must be more than lamp starting voltage.)

Otherwise, the lamps may not be turned on. The used lamp current is the lamp typical current.

- Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
- Let's define the brightness of the lamp after being lighted for 5 minutes as 100%.
 T_S is the time required for the brightness of the center of the lamp to be not less than 95%.
- The lamp power consumption shown above does not include loss of external inverter.
 The used lamp current is the lamp typical current. ($P_{BL} = V_{BL} \times I_{BL} \times N_{Lamp}$)
- The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at $25 \pm 2^\circ\text{C}$.

Product Specification

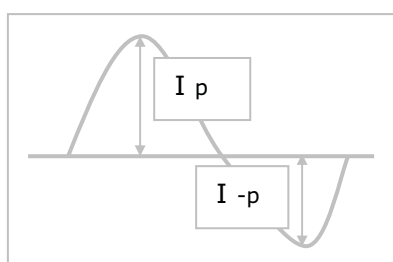
Note :

8. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform (Unsymmetrical ratio is less than 10%). Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following. It shall help increase the lamp lifetime and reduce leakage current.

a. The asymmetry rate of the inverter waveform should be less than 10%.

b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.

* Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

$$| I_p - I_{-p} | / I_{rms} \times 100\%$$

* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

9. The inverter which is combined with this LCM, is highly recommended to connect coupling(ballast) condenser at the high voltage output side. When you use the inverter which has not coupling(ballast) condenser, it may cause abnormal lamp lighting because of biased mercury as time goes.

10. In case of edgy type back light with over 2 parallel lamps, input current and voltage wave form should be synchronized

Product Specification

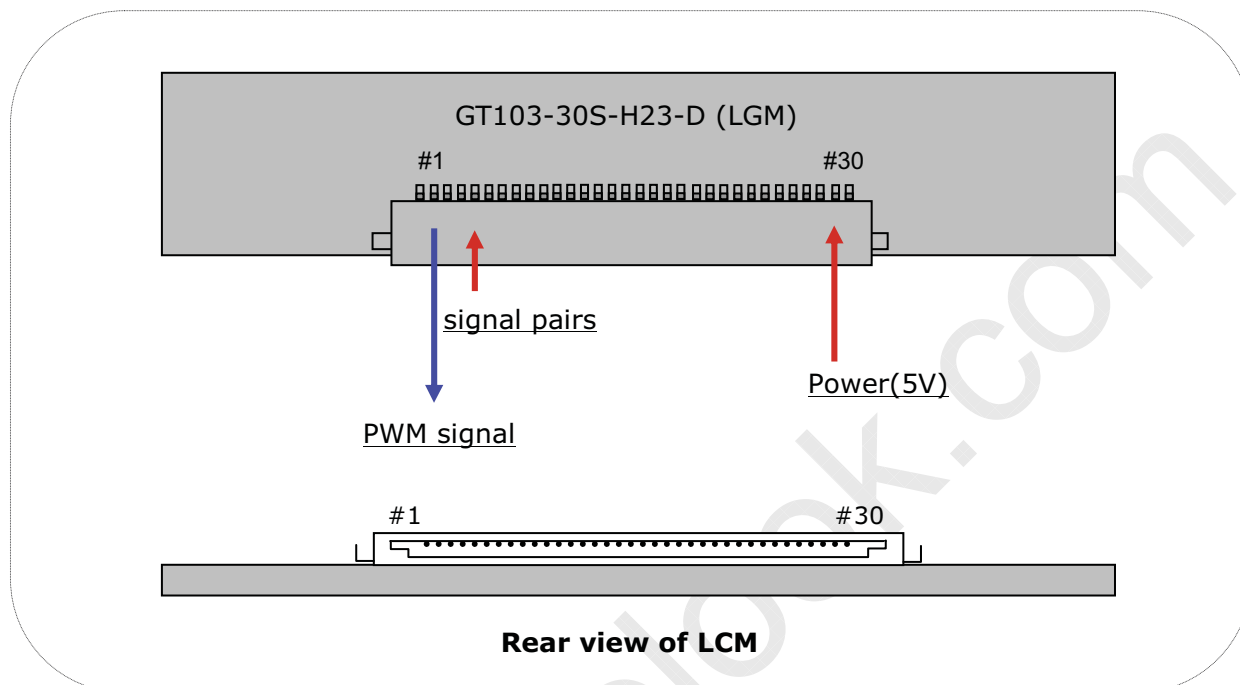
3-2. Interface connections

LCD connector(CN1) : GT103-30S-H23-D (LGM), IS100-L30B-C23 (UJU)

Mating connector : FI-X30H and FI-X30HL (JAE) or Equivalent

Table 4. Module connector(CN1) pin configuration

Pin No	Symbol	Description
1	NC	No Connection (For LCD internal use only.)
2	PWM_OUT	Reference signal for inverter control
3	NC	No Connection (For LCD internal use only.)
4	GND	Ground
5	RX0-	Minus signal of channel 0 (LVDS)
6	RX0+	Plus signal of channel 0 (LVDS)
7	GND	Ground
8	RX1-	Minus signal of channel 1 (LVDS)
9	RX1+	Plus signal of channel 1 (LVDS)
10	GND	Ground
11	RX2-	Minus signal of channel 2 (LVDS)
12	RX2+	Plus signal of channel 2 (LVDS)
13	GND	Ground
14	RXCLK-	Minus signal of clock channel (LVDS)
15	RXCLK+	Plus signal of clock channel (LVDS)
16	GND	Ground
17	RX3-	Minus signal of channel 3 (LVDS)
18	RX3+	Plus signal of channel 3 (LVDS)
19	GND	Ground
20	NC	No Connection (For LCD internal use only.)
21	NC	No Connection (For LCD internal use only.)
22	NC	No Connection (For LCD internal use only.)
23	GND	Ground
24	GND	Ground
25	GND	Ground
26	V _{LCD}	Power Supply (5.0V)
27	V _{LCD}	Power Supply (5.0V)
28	V _{LCD}	Power Supply (5.0V)
29	V _{LCD}	Power Supply (5.0V)
30	V _{LCD}	Power Supply (5.0V)

Product Specification
FIG. 4 Connector diagram

Note:

1. NC: No Connection.
2. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
3. All V_{LCD} (power input) pins should be connected together.
4. Input Level of LVDS signal is based on the IEA 664 Standard.
5. PWM_OUT is a reference signal for inverter control.
 This PWM signal is synchronized with vertical frequency.
 Its frequency is 3 times of vertical frequency, and its duty ratio is 50%.
 If the system don't use this pin, do not connect.

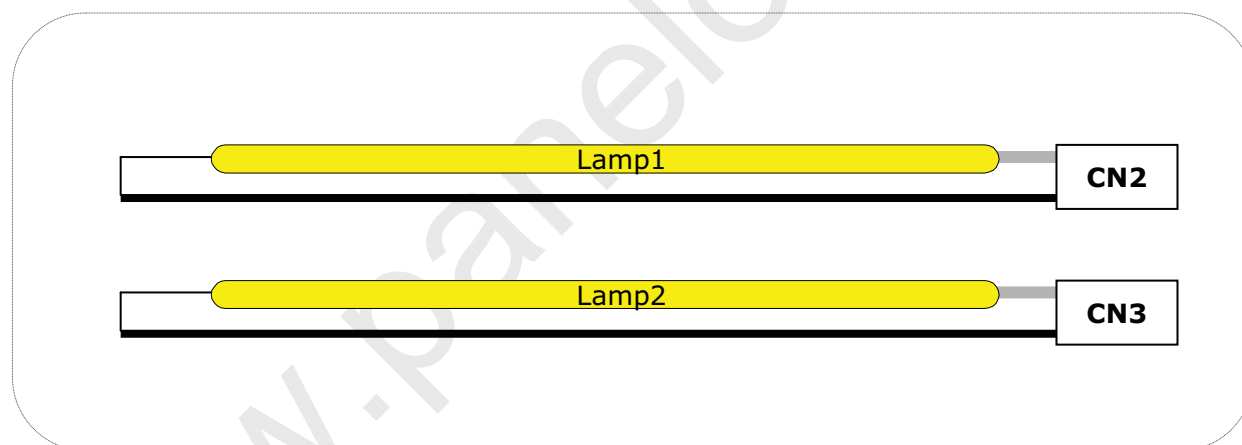
Product Specification

The backlight interface connector is a model 35001HS-02LD manufactured by YEONHO.
The mating connector part number are 35001WR-02L(2pin) or equivalent.
The pin configuration for the connector is shown in the table below.

Table 5. Backlight connector pin configuration(CN2,CN3)

Pin	Symbol	Description	Notes
1	HV	High Voltage for Lamp	1
2	LV	Low Voltage for Lamp	2

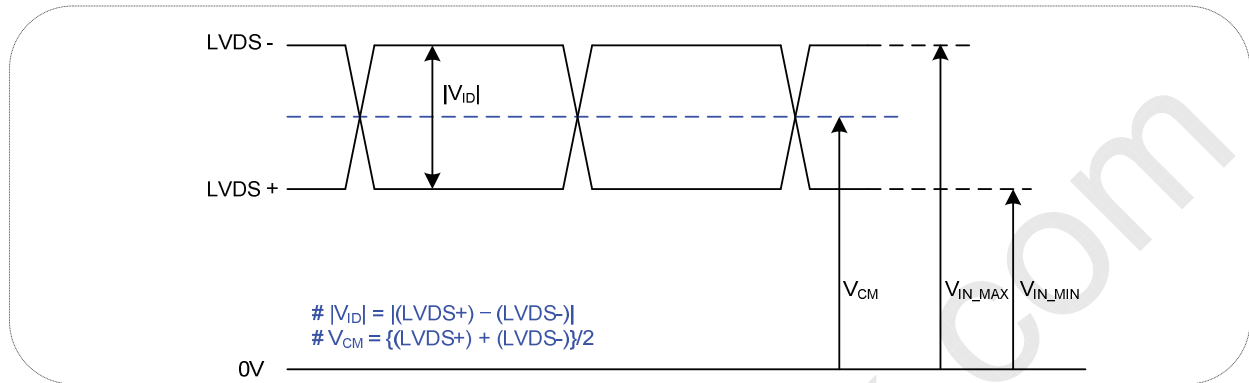
Notes: 1. The high voltage power terminal is colored gray.
2. The low voltage pin color is black.

FIG. 5 Backlight connector diagram

Product Specification

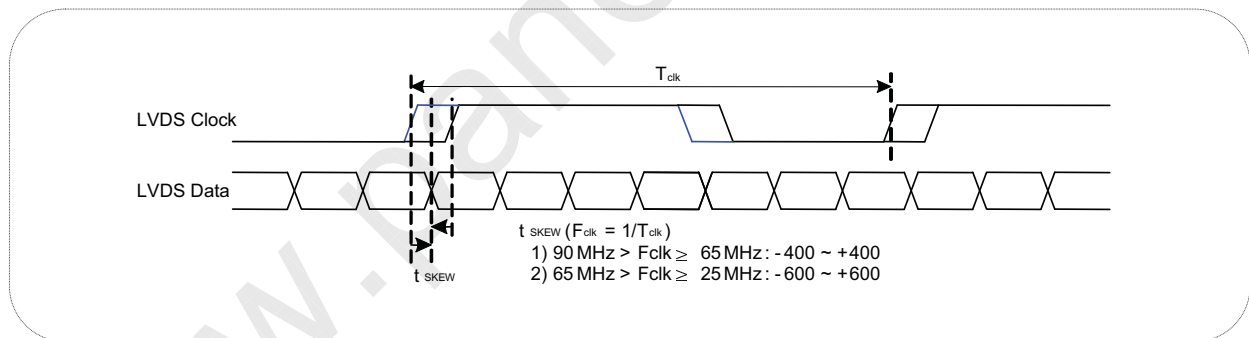
3-3. LVDS characteristics

3-3-1. DC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$ V_{ID} $	200	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	-
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	-

3-3-2. AC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}	- 400	+ 400	ps	90MHz > Fclk ≥ 65MHz
	t_{SKEW}	- 600	+ 600	ps	65MHz > Fclk ≥ 25MHz
Maximum deviation of input clock frequency during SSC	F_{DEV}	-	± 3	%	-
Maximum modulation frequency of input clock during SSC	F_{MOD}	-	200	KHz	-

LM185WH1
Liquid Crystal Display**Product Specification****Table 6. Required signal assignment for Flat Link(NS:DS90CF383) transmitter**

Pin #	Pin Name	Require Signal	Pin #	Pin Name	Require Signal
1	VCC	Power Supply for TTL Input	29	GND	Ground pin for TTL
2	D5	TTL Input (R7)	30	D26	TTL Input (DE)
3	D6	TTL Input (R5)	31	T _x CLKIN	TTL Level clock Input
4	D7	TTL Input (G0)	32	PWR DWN	Power Down Input
5	GND	Ground pin for TTL	33	PLL GND	Ground pin for PLL
6	D8	TTL Input (G1)	34	PLL VCC	Power Supply for PLL
7	D9	TTL Input (G2)	35	PLL GND	Ground pin for PLL
8	D10	TTL Input (G6)	36	LVDS GND	Ground pin for LVDS
9	VCC	Power Supply for TTL Input	37	T _x OUT3 +	Positive LVDS differential data output 3
10	D11	TTL Input (G7)	38	T _x OUT3 -	Negative LVDS differential data output 3
11	D12	TTL Input (G3)	39	T _x CLKOUT +	Positive LVDS differential clock output
12	D13	TTL Input (G4)	40	T _x CLKOUT -	Negative LVDS differential clock output
13	GND	Ground pin for TTL	41	T _x OUT2 +	Positive LVDS differential data output 2
14	D14	TTL Input (G5)	42	T _x OUT2 -	Negative LVDS differential data output 2
15	D15	TTL Input (B0)	43	LVDS GND	Ground pin for LVDS
16	D16	TTL Input (B6)	44	LVDS VCC	Power Supply for LVDS
17	VCC	Power Supply for TTL Input	45	T _x OUT1 +	Positive LVDS differential data output 1
18	D17	TTL Input (B7)	46	T _x OUT1 -	Negative LVDS differential data output 1
19	D18	TTL Input (B1)	47	T _x OUT0 +	Positive LVDS differential data output 0
20	D19	TTL Input (B2)	48	T _x OUT0 -	Negative LVDS differential data output 0
21	GND	Ground pin for TTL Input	49	LVDS GND	Ground pin for LVDS
22	D20	TTL Input (B3)	50	D27	TTL Input (R6)
23	D21	TTL Input (B4)	51	D0	TTL Input (R0)
24	D22	TTL Input (B5)	52	D1	TTL Input (R1)
25	D23	TTL Input (RSVD)	53	GND	Ground pin for TTL
26	VCC	Power Supply for TTL Input	54	D2	TTL Input (R2)
27	D24	TTL Input (HSYNC)	55	D3	TTL Input (R3)
28	D25	TTL Input (VSYNC)	56	D4	TTL Input (R4)

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.

Product Specification
3-4. Signal timing specifications

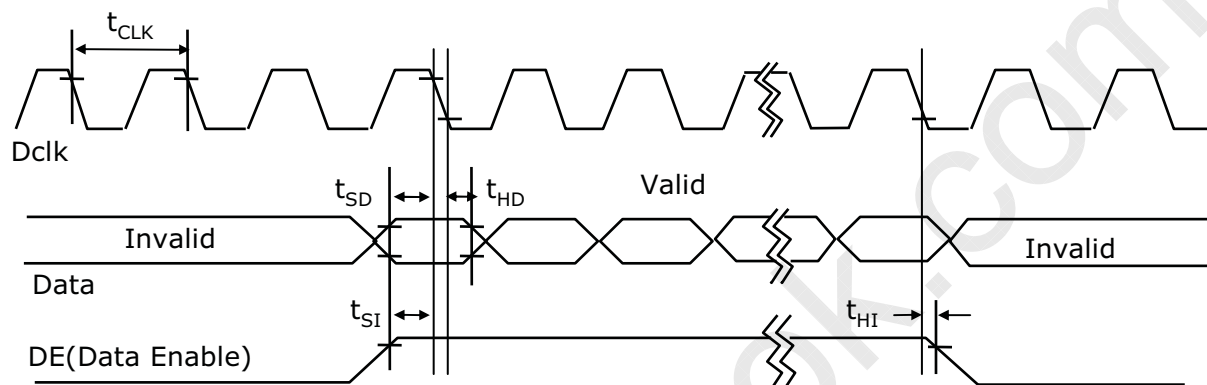
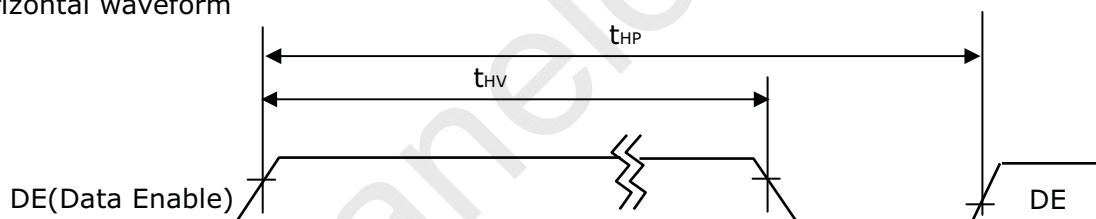
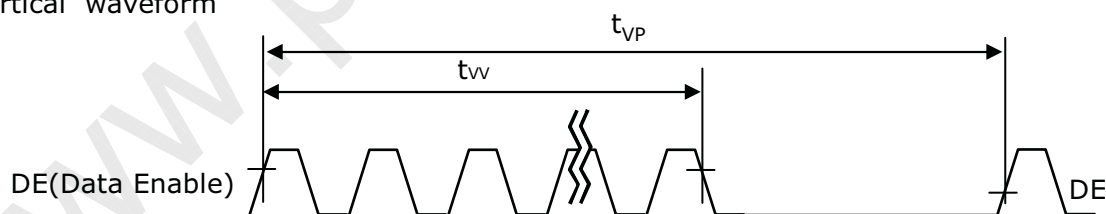
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 7. Timing table

Parameter		Symbol	Min.	Typ.	Max.	Unit	Notes
D_{CLK}	Period	t_{CLK}	11.1	13.0	16.2	ns	
	Frequency	f_{CLK}	61.6	77.0	90.0	MHz	
Horizontal	Horizontal Valid	t_{HV}	1366	1366	1366	t_{CLK}	
	H Period Total	t_{HP}	1430	1608	2044		
	Hsync Frequency	f_H	38.3	47.9	62.0	kHz	
Vertical	Vertical Valid	t_{VV}	768	768	768	t_{HP}	
	V Period Total	t_{VP}	776	798	1108		
	Vsync Frequency	f_V	48	60	76	Hz	
DE (Data Enable)	DE Setup Time	t_{SI}	4	-	-	ns	For D_{CLK}
	DE Hold Time	t_{HI}	4	-	-		
Data	Data Setup Time	t_{SD}	4	-	-	ns	For D_{CLK}
	Data Hold Time	t_{HD}	4	-	-		

Note:

1. LM185WH1-TLH4 is DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

Product Specification
3-5. Signal timing waveforms
1. DCLK, DE, DATA waveforms

2. Horizontal waveform

3. Vertical waveform


Product Specification
3-6. Color input data reference

The brightness of each primary color (red, green and blue) is based on the 8bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 8. Color data reference

Color		Input Color Data																							
		Red								Green								Blue							
		MSB				LSB				MSB				LSB				MSB				LSB			
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Red(000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(002)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255) Bright	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(002)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255) Bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Blue(000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(002)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-----	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0
	Blue(255) Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1

Product Specification

3-7. Power sequence

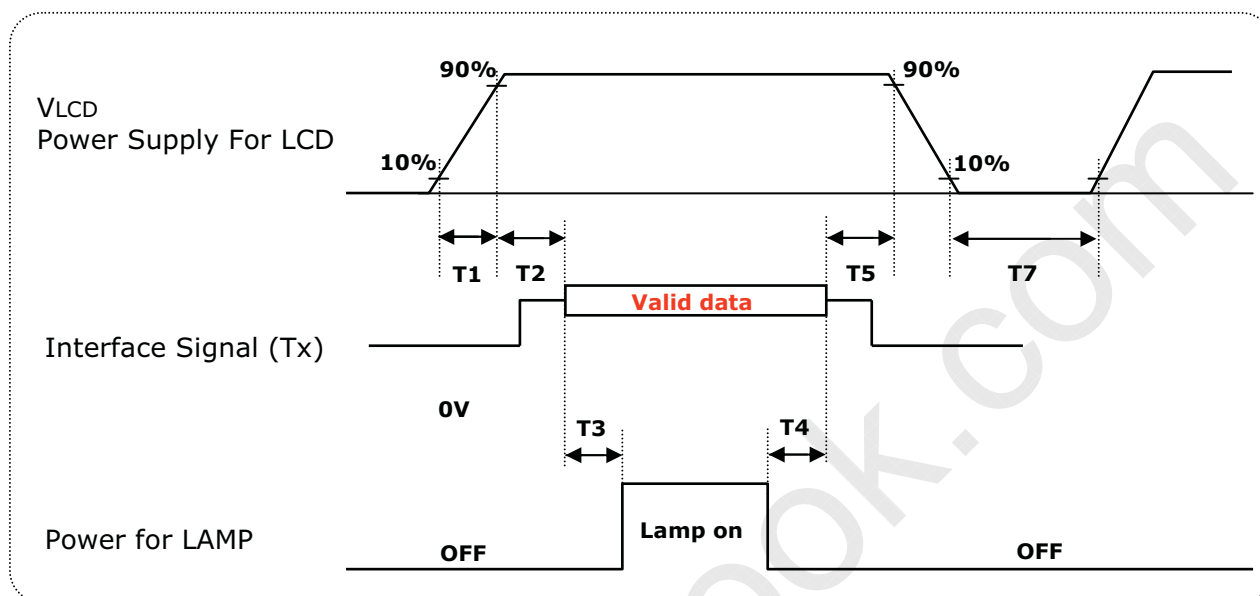


Table 9. Power sequence

Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.01	-	50	ms
T3	500	-	-	ms
T4	200	-	-	ms
T5	0.01	-	50	ms
T7	1	-	-	s

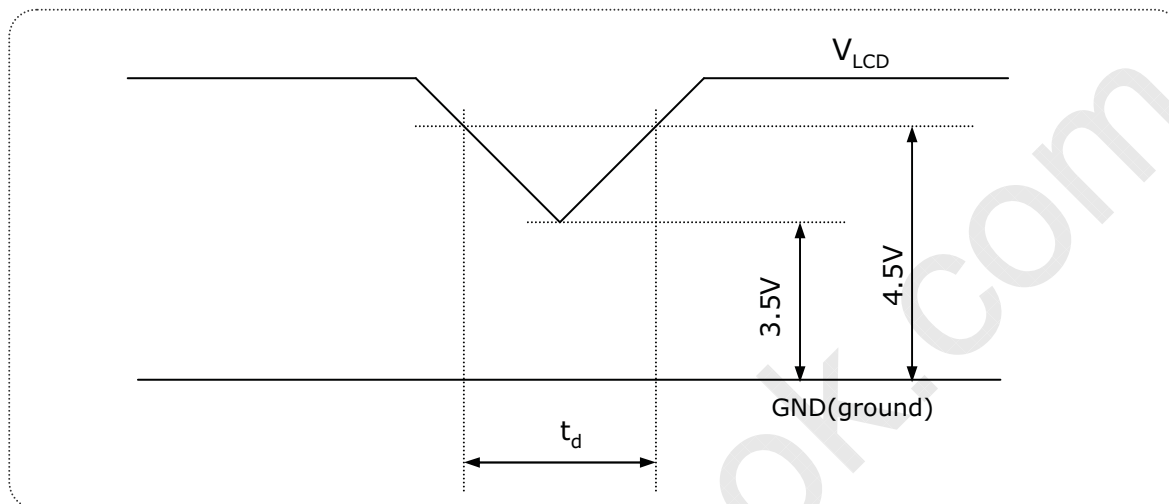
Notes :

1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. Lamp power must be turn on after power supply for LCD an interface signal are valid.

Product Specification

3-8. V_{LCD} Power dip condition

FIG. 6 Power dip condition



1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, t_d \leq 20ms$$

2) $V_{LCD} < 3.5V$ V_{LCD} -dip conditions should also follow the Power On/Off conditions for supply voltage.

Product Specification

4. Optical specification

Optical characteristics are determined after the unit has been 'ON' for 30 minutes in a dark environment at 25°C.

Table 10. Optical characteristics

 Ta= 25°C, V_{LCD}=5.0V, fV=60Hz f_{CLK}= 77.0MHz, IBL=8.5mA

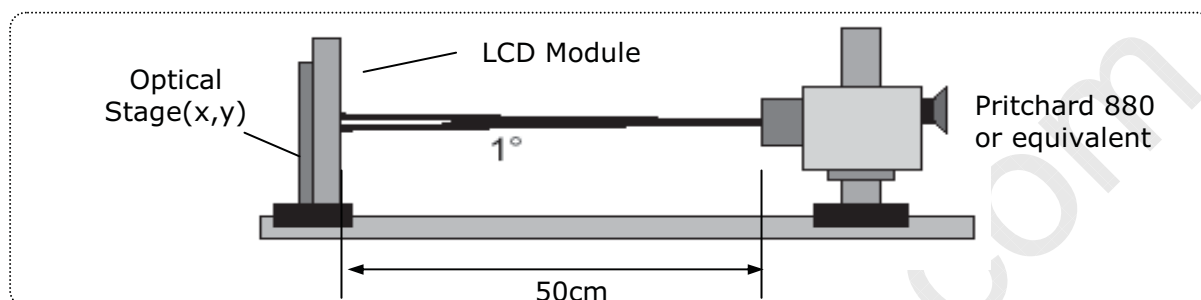
Parameter		Symbol		Values			Units	Notes
				Min	Typ	Max		
Contrast Ratio		CR		400	600	-		1 (PR-880)
Surface Luminance, white		L _{WH}		160	200	-	cd/m²	2 (PR-880)
Luminance Variation		δ _{WHITE}	9P			1.5		3 (PR-880)
Response Time	Rise Time	Tr _R		-	1.1	2.6	ms	4 (RD80S)
	Decay Time	Tr _D		-	3.9	7.4	ms	
Color Coordinates [CIE1931]	RED	Rx		Typ -0.03	0.644	Typ +0.03		(PR-650)
		Ry			0.335			
	GREEN	Gx			0.304			
		Gy			0.613			
	BLUE	Bx			0.146			
		By			0.071			
	WHITE	Wx			0.313			
		Wy			0.329			
Viewing Angle (CR>5)								5 (PR-880)
	x axis, right(φ=0°)		θr	45	50		Degree	
	x axis, left (φ=180°)		θl	45	50			
	y axis, up (φ=90°)		θu	20	25			
	y axis, down (φ=270°)		θd	40	45			
Viewing Angle (CR>10)								5 (PR-880)
	x axis, right(φ=0°)		θr	40	45		Degree	
	x axis, left (φ=180°)		θl	40	45			
	y axis, up (φ=90°)		θu	10	15			
	y axis, down (φ=270°)		θd	30	35			
Crosstalk						1.5	%	(PR-880)

Product Specification

The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0° .

FIG. 7 presents additional information concerning the measurement equipment and method.

FIG. 7 Optical characteristic measurement equipment and method



Notes :

1. Contrast ratio(CR) is defined mathematically as :It is measured at center point(1)

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

2. Surface luminance is the luminance value at center 1 point(1) across the LCD surface 50cm from the surface with all pixels displaying white.
For more information see FIG 8.

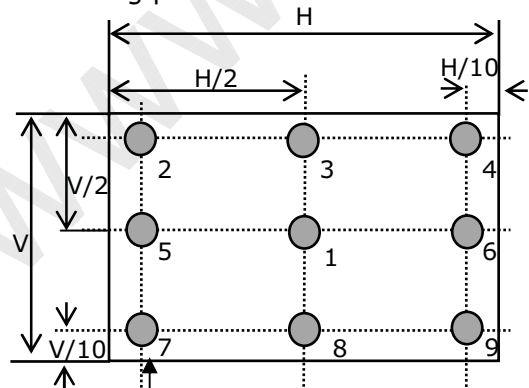
3. The variation in surface luminance , δ_{WHITE} is defined as

$$\delta_{\text{WHITE}} = \frac{\text{Maximum (P1,P2P9)}}{\text{Minimum (P1,P2P9)}}$$

For more information see Figure 8.

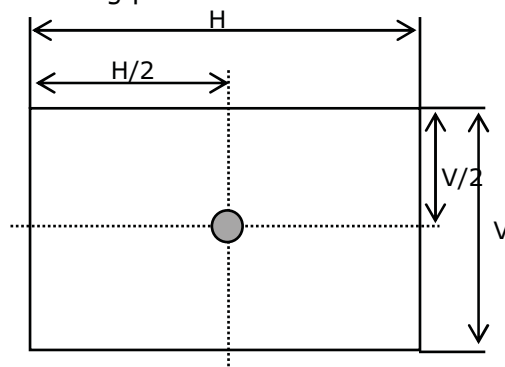
FIG. 8 Luminance measuring point

<Measuring point for luminance variation>



Active Area
 H : 409.800 mm
 V : 230.400 mm
 @ H,V : Active Area

<Measuring point for surface luminance>



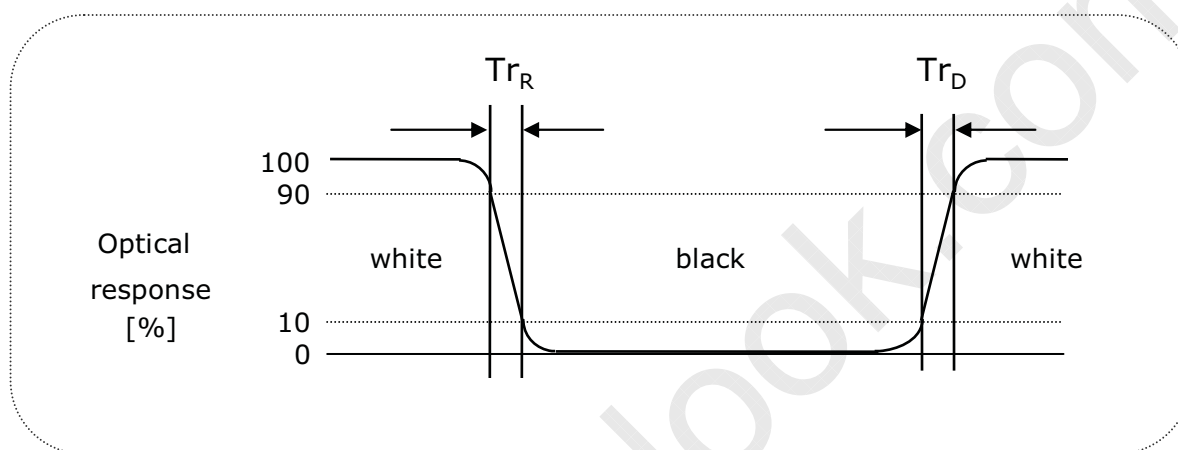
Product Specification

Notes :

4. Response time is the time required for the display to transition from black to white (Decay Time, Tr_D) and from white to black (Rise Time, Tr_R)
The sampling rate is 2,500 sample/sec. For additional information see FIG. 9.

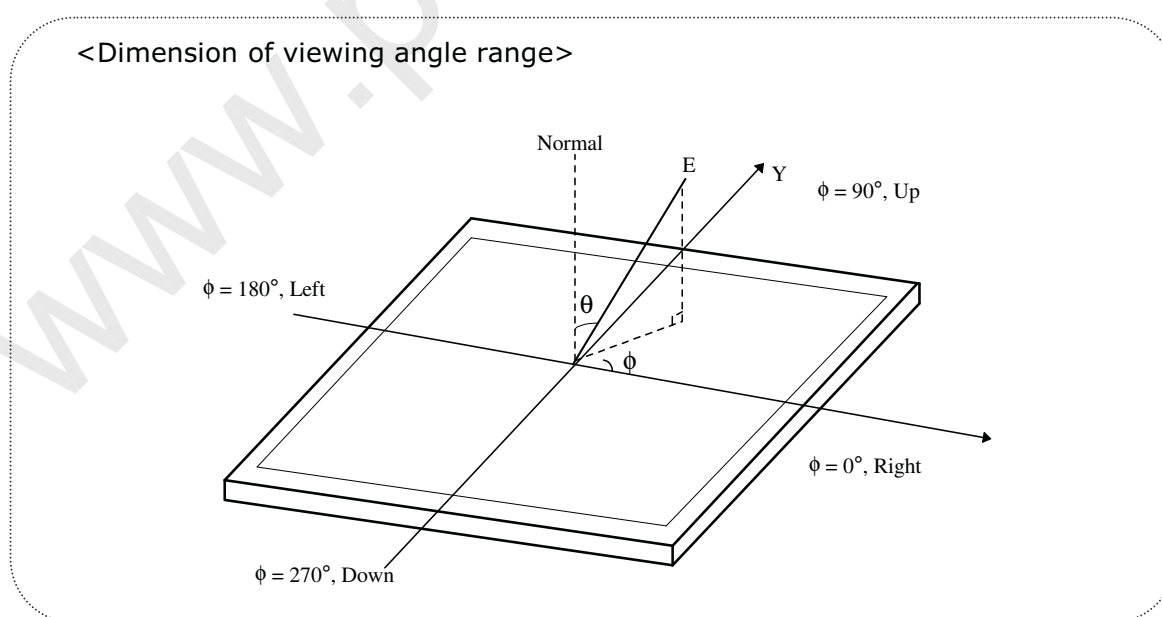
The response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

FIG. 9 Response time



5. Viewing angle is the angle at which the contrast ratio is greater than 10 or 5. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG. 10 .

FIG. 10 Viewing angle



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Liquid Crystal Display**Product Specification**

Notes :

6. Gray scale specification

Table 11. Gray scale

Gray level	Luminance [%] (Typ)
L0	0.10
L31	0.97
L63	4.43
L95	11.06
L127	21.13
L159	38.44
L191	52.50
L223	74.15
L255	100



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Liquid Crystal Display

Product Specification

5. Mechanical characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Table 12. Mechanical characteristics

Outline dimension	Horizontal	430.4 mm
	Vertical	254.6 mm
	Depth	13.0 mm
Bezel area	Horizontal	413.4 mm
	Vertical	234.0 mm
Active display area	Horizontal	409.800 mm
	Vertical	230.400 mm
Weight	1370g(Typ), 1440g(Max)	
Surface treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

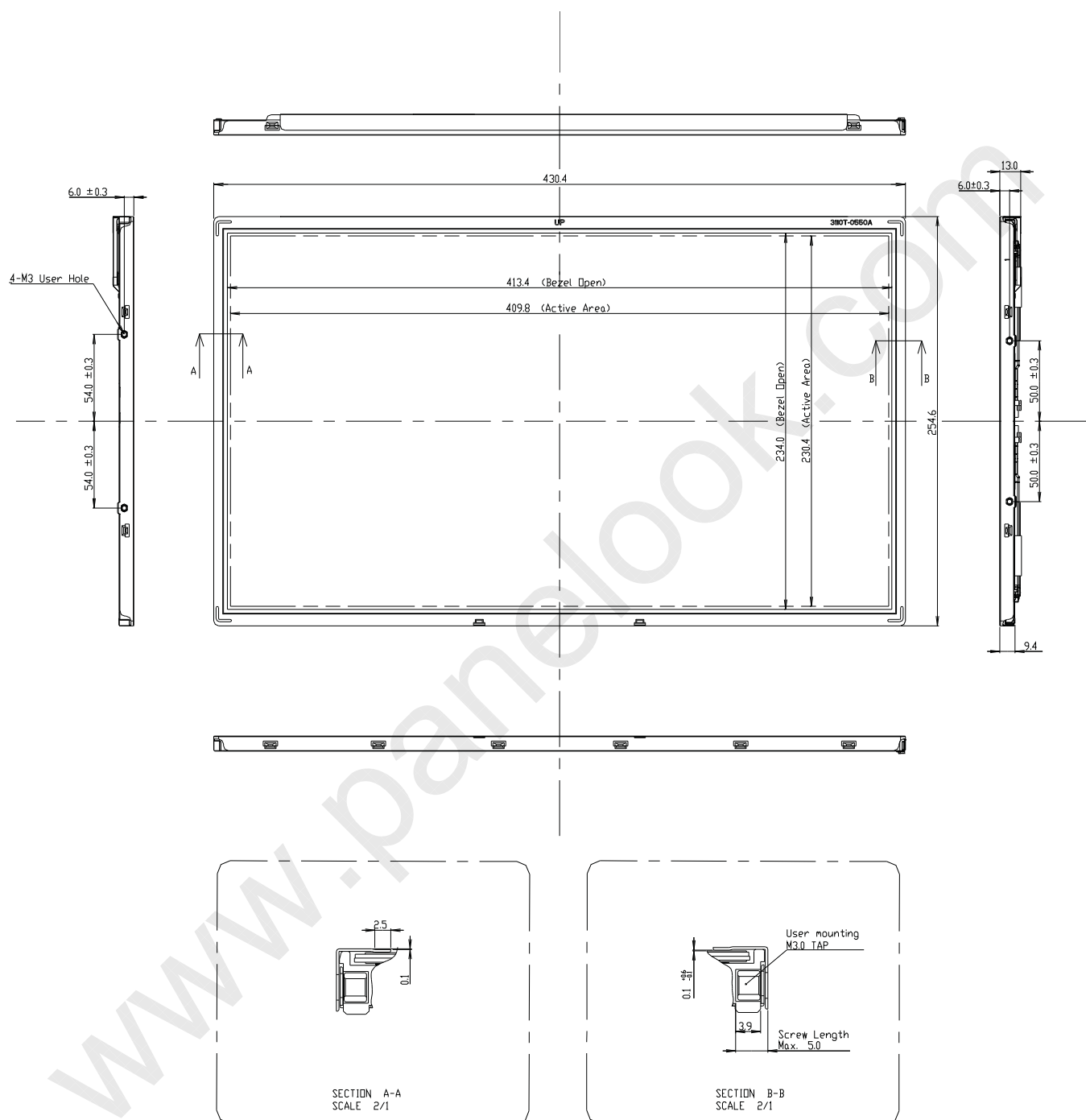
Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.



LM185WH1
Liquid Crystal Display

Product Specification

<FRONT VIEW>



LM185WH1
Liquid Crystal Display**Product Specification****6. Reliability****Table 13. Environment test conditions**

No	Test Item	Condition
1	High temperature storage test	Ta= 60℃ 240hrs
2	Low temperature storage test	Ta= -20℃ 240hrs
3	High temperature operation test	Ta= 50℃ 50%RH 240hrs
4	Low temperature operation test	Ta= 0℃ 240hrs
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0GRMS Bandwidth : 10-300Hz Duration : X,Y,Z, 30 min One time each direction
6	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2msec Direction : ±X, ±Y, ±Z One time each direction
7	Altitude operating storage / shipment	0 - 10,000 feet(3,048m) 0 - 40,000 feet(12,192m)

{ Result evaluation criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.



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Liquid Crystal Display

Product Specification

7. International standards

7-1. Safety

- a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc., Standard for Safety of Information Technology Equipment.
- b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association, Standard for Safety of Information Technology Equipment.
- c) EN 60950-1:2001, First Edition, European Committee for Electro-technical Standardization(CENELEC) European Standard for Safety of Information Technology Equipment.
- d) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz." American National Standards Institute(ANSI),1992
- b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electro-technical Standardization.(CENELEC), 1998 (Including A1: 2000)



LM185WH1
Liquid Crystal Display

Product Specification

8. Packing

8-1. Designation of lot mark

a) Lot mark

A	B	C	D	E	F	G	H	I	J	K	L	M
---	---	---	---	---	---	---	---	---	---	---	---	---

A,B,C : Size (Inch)

E : Month

D : Year

F ~ M : Serial No.

Note:

1. Year

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

2. Month

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of lot mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing form

a) Package quantity in one box : 12 pcs

b) Box size : 350 mm X 300 mm X 470 mm

Product Specification**9. Precautions**

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the Module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.
(Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.

Product Specification**9-3. Electrostatic discharge control**

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for strong light exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. Handling precautions for protection film

- (1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.